GENERAL ATOMICS

September 30, 1998
ENV-2979

VIA EXPRESS DELIVERY
Paula Bisson, Chief
Toxics Section, Cross Media Division
United States Environmental Protection Agency
75 Hawthorne Street
San Francisco, CA 94105-3901

GENERAL ATOMICS
PROPRIETARY DATA

Subject: **Research and Development Test Report for the General Atomics Treatability Study 003**

Reference: Letter from Ms. Paula Bisson (US-EPA) to Keith Asmussen (GA) Dated July 30, 1997

Dear Ms. Bisson:

This letter is to provide the United States Environmental Protection Agency, Region IX (US-EPA) a copy of the test report (Attachment IV) of General Atomics' (GA's) Treatability Study 003, which used Super Critical Water Oxidation (SCWO) to destroy polychlorinated biphenyls (PCBs) in a municipal sewage sludge sample provided by the City of Dayton, Ohio.

In summary, GA's SCWO successfully destroyed the portion of the treatability study sample selected for demonstration, as anticipated. Attachment I includes a chronology of the significant events which occurred during the treatability study.

All treatability sample residuals, test rinsates, and effluents were properly disposed of by a licensed hazardous waste contractor. Attachment II contains a copy of the hazardous waste manifest for the disposal of the treatability study rinsates, as well as the results of laboratory analytical analyses which show that the rinsates were non-PCB. Attachment III contains a copy of the hazardous waste manifest for the disposal of the treatability study residuals and effluents, and includes 1) the laboratory analytical analysis which show that the treatability study effluents were non-PCB, and 2) a letter from Ms. Tracy Reddick at Waste Management, Inc. dated September 17, 1998, documenting the current disposition of the PCB-contaminated sample residual.

GA trusts that the information attached to this letter satisfies the requirements of your above referenced letter. If you have any questions, please do not hesitate to call Paul Englert at (619) 455-2466, or me at (619) 455-2823.

I hereby certify on behalf of General Atomics (GA) that the treatability study conducted by GA Supercritical Water Oxidation for the City of Dayton, Ohio was carried out in accordance with the approved application from U.S. EPA, dated July 30, 1997 and received August 4, 1997. The results of all determinations submitted with this report, including this document and all attachments, were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate and complete.

Very truly yours,

Keith E. Asmussen

Keith E. Asmussen, Ph.D., Director
Licensing, Safety and Nuclear Compliance

KEA:pfe pe092998.kea

Attachments:

I) Chronology of Significant Events

II) Documentation of Disposal of GA Treatability Study 003 Rinsates

III) Documentation of Disposal of GA Treatability Study 003 Residuals and Effluents

IV) Test Report, September 1998

cc: Mr. Yosh Tokiwa, US-EPA (without attachments)

ATTACHMENT I

CHRONOLOGY

Date	Event
8-4-97	Approval for Conducting GA Treatability Study 003 Received From US-EPA
4-14-98	Work-up Tests Conducted Using Chloro-benzene
4-15	Treatability Study Samples Received (Dayton)
4-17	Test Run Using Sewage From Encina Waste Water Treatment Plant
4-21	Test Run Using the Non-PCB Contaminated Dayton Sample
4-24	Preparation of the PCB Contaminated Dayton Sample as Feed Material (Size Reduction and Premixing)
4-27	Test Run Using PCB Contaminated Dayton Sample
4-28	Performed System Upgrades
4-29	Completed Testing of PCB Contaminated Dayton Sample
5-1	Completed System Cleanup Archived Residual Dayton Samples
6-10	Disposal of Rinsate by Hazardous Waste Contractor
7-29	Received Laboratory Report from Sampling Analysis
7-30	Disposal of All Residual Dayton Samples and Effluents
7-31	GA Treatability Study 003 Completed

ATTACHMENT II

State of California—Environmental Protection Agency
Form Approved OMB No. 2050-0039 (Expires 9-30-99)
Please print or type. *Form designed for use on elite (12-pitch) typewriter.*

See Instructions on back of page 6.

Department of Toxic Substances Control
Sacramento, California

98334577

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802: WITHIN CALIFORNIA, CALL 1-800-852-7550

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.: C A D 0 6 7 6 3 8 6 5 7
Manifest Document No.: 5 0 7 6 7
2. Page 1 of 1

Information in the shaded areas is not required by Federal law..

A. State Manifest Document Number: 98334577

3. Generator's Name and Mailing Address
GENERAL ATOMICS
ATTENTION "LSMC"
3550 GENERAL ATOMICS COURT
SAN DIEGO CA 92121

4. Generator's Phone (619) 455-2466

B. State Generator's ID

5. Transporter 1 Company Name: ADVANCED ENVIR TECH SRVS(AETS)
6. US EPA ID Number: N J D 0 8 0 6 3 1 3 6 9

C. State Transporter's ID
D. Transporter's Phone: (973) 347-7111

7. Transporter 2 Company Name
8. US EPA ID Number

E. State Transporter's ID
F. Transporter's Phone

9. Designated Facility Name and Site Address
CHEMICAL WASTE MANAGEMENT
1704 W. FIRST STREET
AZUSA, CA 91702

10. US EPA ID Number: C A D 0 0 8 3 0 2 9 0 3

G. State Facility's ID
H. Facility's Phone: (818) 334-5117

GENERATOR

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a. HAZARDOUS WASTE, LIQUID, n.o.s. (WATER,METHANOL) 9,NA3082,III	003	DF	01200	P	State 223; EPA/Other F003
b. HAZARDOUS WASTE, LIQUID, n.o.s. (WATER,METHANOL) 9,NA3082,III	001	DF	00250	P	State 223; EPA/Other F003
c. HAZARDOUS WASTE, LIQUID, n.o.s. (WATER,METHANOL) 9,NA3082,III	002	DM	00600	P	State 223; EPA/Other F003
d.					State; EPA/Other

J. Additional Descriptions for Materials Listed Above
A)328939 AQUE01 3X55DF
B)328939 AQUE01 1X30DF
C)328939 AQUE01 2X55DM

K. Handling Codes for Wastes Listed Above
a. b. c. d.

15. Special Handling Instructions and Additional Information
PACKING SLIPS ATTACHED FOR CLARIFICATION EMERGENCY PHONE 888-353-2387
C.D. REQUIRED
AETS/CA

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Year
PAUL ENGLERT	[signature]	0 6	1 0	9

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
MATT DESROSIER	[signature]	0 6	1 0	9

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year

DO NOT WRITE BELOW THIS LINE.

DTSC 8022A (4/97)
EPA 8700—22

Yellow: GENERATOR RETAINS

LAND DISPOSAL NOTIFICATION AND CERTIFICATION FORM

AETS

Generator Name: General Atomics EPA ID # CAD067638957 State Manifest No. 98334577

1. If waste is a wastewater (see 40 CFR 268.2) place "w" next to the applicable code(s)
2. If waste is subject to any California List restriction enter the letter from below next to each restriction that is applicable. __ HOC, __ PCBs, __ Metals __ Acid

3. CODES WITH SUBCATEGORIES (place appropriate letter from section 9 before each code that applies) (See 40 CFR 268 for details)

____ D001 Hi-TOC	____ D003 Unexp Ord. Emg	____ K006 Hydrated	____ P047 Salts	____ P092 Hi Inc//RMERC Res.
____ D001 < 10% TOC-CWA	____ D003 Other Reactives	____ K006 Anhydrous	____ P047 Nonsalts	____ U151 Lo RMERC Res.
____ D001 < 10% TOC-Non/CWA	____ D006 Batteries	____ K069 Calcium Sulfate	____ P065 Lo Inc. Res.	____ U151 Lo Not RMERC Res.
____ D002 Non-CWA	____ D008 Lead acid batteries	____ K069 Not Calcium Sulfate	____ P065 Lo RMERC Res.	____ U151 Hi Hg
____ D002 CWA	____ D009 Organic Hg > 260ppm	____ K071 Rmerc Res.	____ P065 Not Inc./RMERC Res.	____ U240 2, 4 D
____ D003 Reactive Cyanide	____ D009 Inorg. Hg > 260	____ K071 Not Rmerc Res.	____ P065 Hi Inc./RMERC Res.	____ U240 2, 4 esters & Salts
____ D003 Reactive Sulfide	____ D009 Hg < 260	____ K106 Lo Rmerc Res.	____ P092 Lo Inc. Res.	
____ D003 Explosive	____ F025 Light ends	____ K106 Not Rmerc Res.	____ P092 Lo RMERC Res.	
____ D003 Water Reactives	____ F025 Spent filter	____ K106 > 260 ppm Hg	____ P092 Not Inc/RMERC Res.	

The subcategory for D018-D043 waste is "treated in nonCWA/nonSDWA facility" unless the following box is checked: ☐ "treated in CWA/SDWA facility"

4. COMMON CODES (Place appropriate letter from section 9 before each code that applies)

___ D004	___ D005	___ D006	___ D007	___ D008	___ D009	___ D010	___ D011	___ D012	___ D013	___ D014	___ D015	___ D016	___ D017	___ D018	___ D0
___ D020	___ D021	___ D022	___ D023	___ D024	___ D025	___ D026	___ D027	___ D028	___ D029	___ D030	___ D031	___ D032	___ D033	___ D034	___ D0
___ D036	___ D037	___ D038	___ D039	___ D040	___ D041	___ D042	___ D043	___ F001	___ F002	A F003	___ F004	___ F005	___ U002	___ U003	___ U0
___ U007	___ U044	___ U061	___ U072	___ U080	___ U108	___ U117	___ U122	___ U123	___ U136	___ U154	___ U188	___ U213	___ U220	___ U226	___ U2
___ P012	___ P030	___ P051	___ P098	___ P105	___ P205	___ F006	___ F007	___ F008	___ F009	___ F010	___ F011	___ F012	___ F019	___ F039	___ K0

ADDITIONAL CODES (Enter all codes not identified above which are associated with waste)

5. USEPA HAZARDOUS WASTE CODE(S)	6. TREATMENT STANDARDS FOR NON-PHASE II STATES (INDICATE THE APPLICABLE TREATMENT STANDARD 268.41, 268.43 OR SPECIFIED TECHNOLOGY BELOW)	7. HOW MUST THE WASTE BE MANAGED? ENTER THE LETTER FROM BELOW

To identify F039, or UHCs managed in non-CWA, use the "F039/Underlying Hazardous Constituents Form" provided (CWM-2004) and check here: ☐
If no UHCs are present upon generation check here ☒ Check here if disposal facility will check for all UHCs ☐ (i.e. no UHC form required)
To list additional EPA waste code(s), use the supplemental sheet and check here: ☐ In lieu of supplemental sheet you may use multiple copies of this form.

8. SOLVENT CONSTITUENTS (F001 - F005) Check here if disposal facility will check for all spent solvents ___

___ Acetone	___ Benzene	___ n-Butyl alcohol	___ Carbon disulfide
___ Carbon Tetrachloride	___ Chlorobenzene	___ O-Cresol	___ Cresols (m&p)
___ Cyclohexanone	___ o-Dichlorobenzene	___ 2-Ethoxyethanol	___ Ethyl acetate
___ Ethyl benzene	___ Ethyl ether	___ Isobutanol	✓ Methanol
___ Methylene chloride	___ Methyl ethyl ketone	___ Methyl isobutyl ketone	___ Nitrobenzene
___ 2-Nitropropane	___ Pyridine	___ Tetrachloroethylene	___ Toluene
___ 1,1,1 Trichloroethane	___ 1, 1, 2-Trichloroethane	___ 1, 1, 2-Trichloro, 1, 2, 2-trifluoroethane	___ Trichloroethylene
___ Trichloromonofluoromethane	___ Xylenes		

9. (States authorized by EPA to manage the LDR program may have regulatory citations different from the 40 CFR citations listed below. Where these regulatory citations differ, your certification will be deemed to refer to those state citations instead of the 40 CFR citations.)

A. Or ✓ RESTRICTED WASTE REQUIRES TREATMENT
This waste must be treated to the applicable treatment standards set forth in 40 CFR Part 268 Subpart D, 268.32, or RCRA Section 3004(d)
☐ For Hazardous Debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

B.1 RESTRICTED WASTE TREATMENT TO PERFORMANCE STANDARDS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the treatment process has been operated and maintained properly so as to comply with the performance levels specified in 40 CFR Part 268, Subpart D, and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA section 3004(d) without impermissible dilution of the prohibited waste. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.2 RESTRICTED WASTES FOR WHICH THE TREATMENT STANDARD IS EXPRESSED AS A SPECIFIED TECHNOLOGY (AND THE WASTE HAS BEEN TREATED BY THAT TECHNOLOGY)
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.42. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.3 GOOD FAITH AND ANALYTICAL CERTIFICATION - FOR INCINERATED ORGANICS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the nonwastewater organic constituents have been treated by incineration in units operated in accordance with 40 CFR Part 264, Subpart O, or 40 CFR Part 265, Subpart O, or by combustion in fuel substitution units operating in accordance with applicable technical requirements, and I have been unable to detect the nonwastewater organic constituents despite having used best good faith efforts to analyze for such constituents. I am aware that there are a significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.4 DECHARACTERIZED WASTE REQUIRES TREATMENT FOR UNDERLYING HAZARDOUS CONSTITUENTS
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.40 to remove the hazardous characteristic. This decharacterized waste contains underlying hazardous constituents that require further treatment to meet universal treatment standards. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

C. RESTRICTED WASTE SUBJECT TO A VARIANCE
This waste is subject to a national capacity variance, a treatability variance, or a case-by-case extension. Enter the effective date of prohibition in column 7 above.
☐ For hazardous debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

D. RESTRICTED WASTE CAN BE LAND DISPOSED WITHOUT FURTHER TREATMENT
"I have determined that this waste meets all applicable treatment standards set forth in 40 CFR Part 268 Subpart D, and all applicable prohibition levels set forth in Section 268.32 or RCRA Section 3004(d), and therefore, can be land disposed without further treatment. A copy of all applicable treatment standards and specified treatment methods is maintained at the treatment, storage and disposal facility named above." "I certify under penalty of law that I have personally examined and am familiar with the waste through analysis and testing or thorough knowledge of the waste to support this certification that the waste complies with the treatment standards specified in 40 CFR Part 268 Subpart D and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA Section 3004(d). I believe that the information I submitted is true, accurate and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment."

E. WASTE IS NOT CURRENTLY SUBJECT TO PART 268 RESTRICTIONS
This waste is a newly identified waste that is not currently subject to any 40 CFR Part 268 restrictions.

I hereby certify that all information in this and all associated documents is complete and accurate, to the best of my knowledge and information.

Signature [signature]

Title ENVIRONMENTAL COORDINATOR Date 6/10/98

WAETS-7

GENERATOR COPY

Calscience Environmental Laboratories, Inc.

May 22, 1998

Chris Rogers
Advanced Environmental Technical Services
5202 Oceanus Drive
Huntington Beach, CA 92649

Subject: **Calscience Work Order Number: 98-05-0463**
Client Reference: General Atomics

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 05/15/98 and analyzed in accordance with the attached chain-of-custody.

The results in this analytical report are limited to the samples tested, and any reproduction of this report must be made in its entirety.

If you have any questions regarding this report, require sampling supplies or field services, or information on our analytical services, please feel free to call me at (714) 895-5494.

Sincerely,

Calscience Environmental
Laboratories, Inc.
Don Burley
Project Manager

William H. Christensen
Deliverables Manager

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT
EPA 8081 PCBs

Client Name:	Advanced Environmental Technical Services		
Project ID:	General Atomics		
Work Order Number:	98-05-0463		
QC Batch ID:	9805186	Date Collected:	05/13/98
Matrix:	Aqueous	Date Received:	05/15/98
Preparation:	EPA 3520B	Date Prepared:	05/19/98
Method:	EPA 8081	Date Analyzed:	05/21/98

Client Sample Number: DRUM #A
Lab Sample Number: 98-05-0463-1

Parameter	Result	RL	Qualifiers	Units
Aroclor-1016	ND	33.3		ug/L
Aroclor-1221	ND	33.3		ug/L
Aroclor-1232	ND	33.3		ug/L
Aroclor-1242	ND	33.3		ug/L
Aroclor-1248	113	33.3		ug/L
Aroclor-1254	69.9	33.3		ug/L
Aroclor-1260	ND	33.3		ug/L
Aroclor-1262	ND	33.3		ug/L

Surrogates:	REC (%)	Control Limits	Qualifiers
Decachlorobiphenyl	87	50-135	
2,4,5,6-Tetrachloro-m-Xylene	70	50-135	

Muhmw

7440 Lincoln Way, Garden Grove, CA 92841-1432 • TEL: (714) 895-5494 • FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT
EPA 8081 PCBs

Client Name:	Advanced Environmental Technical Services		
Project ID:	General Atomics		
Work Order Number:	98-05-0463		
QC Batch ID:	9805186	Date Collected:	05/13/98
Matrix:	Aqueous	Date Received:	05/15/98
Preparation:	EPA 3520B	Date Prepared:	05/19/98
Method:	EPA 8081	Date Analyzed:	05/21/98

Client Sample Number: DRUM #B
Lab Sample Number: 98-05-0463-2

Parameter	Result	RL	Qualifiers	Units
Aroclor-1016	ND	33.3		ug/L
Aroclor-1221	ND	33.3		ug/L
Aroclor-1232	ND	33.3		ug/L
Aroclor-1242	ND	33.3		ug/L
Aroclor-1248	173	33.3		ug/L
Aroclor-1254	153	33.3		ug/L
Aroclor-1260	ND	33.3		ug/L
Aroclor-1262	ND	33.3		ug/L

Surrogates:	REC (%)	Control Limits	Qualifiers
Decachlorobiphenyl	94	50-135	
2,4,5,6-Tetrachloro-m-Xylene	80	50-135	

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Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT
EPA 8081 PCBs

Client Name:	Advanced Environmental Technical Services		
Project ID:	General Atomics		
Work Order Number:	98-05-0463		
QC Batch ID:	9805186	Date Collected:	N/A
Matrix:	Aqueous	Date Received:	N/A
Preparation:	EPA 3520B	Date Prepared:	05/19/98
Method:	EPA 8081	Date Analyzed:	05/21/98

Client Sample Number: **Method Blank**
Lab Sample Number: 095-01-015-325

Parameter	Result	RL	Qualifiers	Units
Aroclor-1016	ND	1.00		ug/L
Aroclor-1221	ND	1.00		ug/L
Aroclor-1232	ND	1.00		ug/L
Aroclor-1242	ND	1.00		ug/L
Aroclor-1248	ND	1.00		ug/L
Aroclor-1254	ND	1.00		ug/L
Aroclor-1260	ND	1.00		ug/L
Aroclor-1262	ND	1.00		ug/L

Surrogates:	REC (%)	Control Limits	Qualifiers
Decachlorobiphenyl	126	50-135	
2,4,5,6-Tetrachloro-m-Xylene	113	50-135	

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

EPA 8081 PCBs

LCS/LCSD Batch Number: 9805186
Matrix: Aqueous
Method: EPA 8081

Instrument: GC 10
Date Extracted: 05/19/98
Date Analyzed: 05/21/98

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Aroclor-1260	100	96	50-135	4	0-25	

7440 Lincoln Way, Garden Grove, CA 92841-1432 • TEL: (714) 895-5494 • FAX: (714) 894-7501

Calscience Environmental Laboratories, Inc.

GLOSSARY OF TERMS AND QUALIFIERS

Work Order Number: 98-05-0463

Qualifier	Definition
ND	Not detected at indicated reporting limit.

7440 Lincoln Way, Garden Grove, CA 92841-1432 • TEL: (714) 895-5494 • FAX: (714) 894-7501

AETS
ADVANCED ENVIRONMENTAL TECHNICAL SERVICES

463

SAMPLE SHIPPING DOCUMENT/ CHAIN OF CUSTODY

Number ______
Page 1 of 1

AETS Client: GENERAL ATOMICS
3550 GENERAL ATOMICS COURT
SAN DIEGO, CA 92121
ATTN: LSAIC

Laboratory Name: CAL SCIENCE
Contact Name: ______

Shipping Information

Proper Shipping Name	# Units	Total Quantity
TOXIC LIQUIDS, ORGANIC, N.O.S., 6.1, UN2810, III		

IN CASE OF EMERGENCY CALL 1-800-353-2387

Project Description (WIP #)

Reporting Type: NJ Reg Format, NJ Reduced Format, CLP, Level II, Level I (Data Sum), Other ______

TAT: 1 wk, 2 wk, 3 wk
Other ______

NO. OF SAMPLE CONTAINERS: 2

SAMPLE LOCATION	DATE	TIME (Military)	SAMPLE NUMBER	Volatile Organic Compounds	Acid Extractable Compounds	Base/Neutral Extractable Compounds	CN Total/Amenable Method 9010	PCB's	Metals TCLP	BETX	Petroleum Hydrocarbons	TCLP Full	Ignitability	Corrosivity	(Other) (Boric Acid)		
DRUM #A (HIGH)	5-13-98	10:30	HIGH #A				X										
DRUM #B	5-13-98	10:30	#B				X										
~~SOLID #C~~	~~5-13-98~~	~~10:30~~	~~#C~~										[illegible]				

Relinquished by (signature):	Date	Time (Military)	Received by (Signature)	Date	Time (Military)	Relinquished by (signature):	Date	Time (Military)	Received by (Signature)	Date	Time (Military)
[signature]	5/13/98	1315	[signature]	5-13-98	10:30	[signature]			[signature]	5/15/98	1015
[signature]	5/15/98	1800	[signature]	5/15/98	1800						

Send Results to AETS ______

VIA: Verbal ☐ Fax ☐ Fed X ☐ Regular ☒

Purchase Order # 4265 Work Order # ______

REMARKS:

ATTACHMENT III

State of California—Environmental Protection Agency
Form Approved OMB No. 2050-0039 (Expires 9-30-99)
Please print or type. Form designed for use on elite (12-pitch) typewriter.

See Instructions on back of page 6.

Department of Toxic Substances Control
Sacramento, California

IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-852-7550

98329695

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.: C A D 0 6 7 6 3 8 9 5 7
Manifest Document No.: 5 8 1 3 0
2. Page 1 of 1
Information in the shaded areas is not required by Federal law.

GENERATOR

3. Generator's Name and Mailing Address
GENERAL ATOMICS
ATTENTION "LSNC"
3550 GENERAL ATOMICS COUR
SAN DIEGO CA 92121

A. State Manifest Document Number: 98329695

B. State Generator's ID

4. Generator's Phone (619) 455-2466

5. Transporter 1 Company Name: ADVANCED ENVIR TECH SRVS(AETS)
6. US EPA ID Number: N J D 0 8 0 6 3 1 3 6 9

C. State Transporter's ID
D. Transporter's Phone (973) 347-7111

7. Transporter 2 Company Name
8. US EPA ID Number

E. State Transporter's ID
F. Transporter's Phone

9. Designated Facility Name and Site Address
CHEMICAL WASTE MANAGEMENT, INC
35251 OLD SKYLINE ROAD
P.O. BOX 471
KETTLEMAN CITY, CA 93239
10. US EPA ID Number: C A T 0 0 0 6 4 6 1 1 7

G. State Facility's ID
H. Facility's Phone (209) 386-9711

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a. RQ HAZARDOUS WASTE, LIQUID, n.o.s. (POLYCHLORINATED BIPHENYLS, LEAD) 9,NA3082,III (POLYCHLORINATED BIPHENYLS,D008)	001	DF	00150	P	State 261; EPA/Other D008
b. RQ HAZARDOUS WASTE, LIQUID, n.o.s. (POLYCHLORINATED BIPHENYLS, LEAD) 9,NA3082,III (POLYCHLORINATED BIPHENYLS,D008)	001	DF	00200	P	State 261; EPA/Other D008
c.					State; EPA/Other
d.					State; EPA/Other

J. Additional Descriptions for Materials Listed Above
A)329038 KHFBC4829 1X55DF
B)329038 KHFBC4829 1X85DF

K. Handling Codes for Wastes Listed Above
a. b.
c. d.

15. Special Handling Instructions and Additional Information
PACKING SLIPS ATTACHED FOR CLARIFICATION EMERGENCY PHONE 888 353-2387
C.D. REQUIRED
AETS/CA

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Month	Day	Year
Paul Englert	[signature]	07	30	9

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
Matt Desrosier	[signature]	07	30	98

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Month	Day	Year

DO NOT WRITE BELOW THIS LINE.

DTSC 8022A (4/97)
EPA 8700—22

Yellow: GENERATOR RETAINS

Waste Management

AETS/CWM LAND DISPOSAL NOTIFICATION AND CERTIFICATION FORM

Generator Name: General Atomics EPA ID # CAD067638957 State Manifest No. 98329695

1. If waste is a wastewater (see 40 CFR 268.2) place "w" next to the applicable code(s)
2. If waste is subject to any California List restriction enter the letter from below next to each restriction that is applicable. __ HOC, __ PCBs, __ Metals __ Acid

3. CODES WITH SUBCATEGORIES (place appropriate letter from section 9 before each code that applies) (See 40 CFR 268 for details)

____ D001 Hi-TOC	____ D003 Unexp Ord. Emg	____ K006 Hydrated	____ P047 Salts	____ P092 Hi Inc//RMERC Res.
____ D001 < 10% TOC-CWA	____ D003 Other Reactives	____ K006 Anhydrous	____ P047 Nonsalts	____ U151 Lo RMERC Res.
____ D001 < 10% TOC-Non/CWA	____ D006 Batteries	____ K069 Calcium Sulfate	____ P065 Lo Inc. Res.	____ U151 Lo Not RMERC Res.
____ D002 Non-CWA	____ D008 Lead acid batteries	____ K069 Not Calcium Sulfate	____ P065 Lo RMERC Res.	____ U151 Hi Hg
____ D002 CWA	____ D009 Organic Hg > 260ppm	____ K071 Rmerc Res.	____ P065 Not Inc./RMERC Res.	____ U240 2, 4 D
____ D003 Reactive Cyanide	____ D009 Inorg. Hg > 260	____ K071 Not Rmerc Res.	____ P065 Hi Inc./RMERC Res.	____ U240 2, 4 esters & Salts
____ D003 Reactive Sulfide	____ D009 Hg < 260	____ K106 Lo Rmerc Res.	____ P092 Lo Inc. Res.	
____ D003 Explosive	____ F025 Light ends	____ K106 Not Rmerc Res.	____ P092 Lo RMERC Res.	
____ D003 Water Reactives	____ F025 Spent filter	____ K106 > 260 ppm Hg	____ P092 Not Inc/RMERC Res.	

The subcategory for D018-D043 waste is "treated in nonCWA/nonSDWA facility" unless the following box is checked: ☐ "treated in CWA/SDWA facility"

4. COMMON CODES (Place appropriate letter from section 9 before each code that applies)

___D004	___D005	___D006	___D007	A D008	___D009	___D010	___D011	___D012	___D013	___D014	___D015	___D016	___D017	___D018	___D01
___D020	___D021	___D022	___D023	___D024	___D025	___D026	___D027	___D028	___D029	___D030	___D031	___D032	___D033	___D034	___D03
___D036	___D037	___D038	___D039	___D040	___D041	___D042	___D043	___F001	___F002	___F003	___F004	___F005	___U002	___U003	___U00
___U007	___U044	___U061	___U072	___U080	___U108	___U117	___U122	___U123	___U136	___U154	___U188	___U213	___U220	___U226	___U27
___P012	___P030	___P051	___P098	___P105	___P205	___F006	___F007	___F008	___F009	___F010	___F011	___F012	___F019	___F039	___K06

ADDITIONAL CODES (Enter all codes not identified above which are associated with waste)

5. USEPA HAZARDOUS WASTE CODE(S)	6. TREATMENT STANDARDS FOR NON-PHASE II STATES (INDICATE THE APPLICABLE TREATMENT STANDARD 268.41, 268.43 OR SPECIFIED TECHNOLOGY BELOW)	7. HOW MUST THE WASTE BE MANAGED? ENTER THE LETTER FROM BELOW

To identify F039, or UHCs managed in non-CWA, use the "F039/Underlying Hazardous Constituents Form" provided (CWM-2004) and check here: ☐
If no UHCs are present upon generation check here: ☒ Check here if disposal facility will check for all UHCs ☐ (i.e. no UHC form required)
To list additional EPA waste code(s), use the supplemental sheet and check here: ☐ In lieu of supplemental sheet you may use multiple copies of this form.

8. SOLVENT CONSTITUENTS (F001 - F005) Check here if disposal facility will check for all spent solvents ___

____ Acetone	____ Benzene	____ n-Butyl alcohol	____ Carbon disulfide
____ Carbon Tetrachloride	____ Chlorobenzene	____ O-Cresol	____ Cresols (m&p)
____ Cyclohexanone	____ o-Dichlorobenzene	____ 2-Ethoxyethanol	____ Ethyl acetate
____ Ethyl benzene	____ Ethyl ether	____ Isobutanol	____ Methanol
____ Methylene chloride	____ Methyl ethyl ketone	____ Methyl isobutyl ketone	____ Nitrobenzene
____ 2-Nitropropane	____ Pyridine	____ Tetrachloroethylene	____ Toluene
____ 1,1,1 Trichloroethane	____ 1, 1, 2-Trichloroethane	____ 1, 1, 2-Trichloro, 1, 2, 2-trifluoroethane	____ Trichloroethylene
____ Trichloromonofluoromethane	____ Xylenes		

9. (States authorized by EPA to manage the LDR program may have regulatory citations different from the 40 CFR citations listed below. Where these regulatory citations differ, your certification will be deemed to refer to those state citations instead of the 40 CFR citations.)

A. Or ✓ RESTRICTED WASTE REQUIRES TREATMENT
This waste must be treated to the applicable treatment standards set forth in 40 CFR Part 268 Subpart D, 268.32, or RCRA Section 3004(d)
☐ For Hazardous Debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

B.1 RESTRICTED WASTE TREATMENT TO PERFORMANCE STANDARDS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the treatment process has been operated and maintained properly so as to comply with the performance levels specified in 40 CFR Part 268, Subpart D, and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA section 3004(d) without impermissible dilution of the prohibited waste. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.2 RESTRICTED WASTES FOR WHICH THE TREATMENT STANDARD IS EXPRESSED AS A SPECIFIED TECHNOLOGY (AND THE WASTE HAS BEEN TREATED BY THAT TECHNOLOGY)
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.42. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.3 GOOD FAITH AND ANALYTICAL CERTIFICATION - FOR INCINERATED ORGANICS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the nonwastewater organic constituents have been treated by incineration in units operated in accordance with 40 CFR Part 264, Subpart O, or 40 CFR Part 265, Subpart O, or by combustion in fuel substitution units operating in accordance with applicable technical requirements, and I have been unable to detect the nonwastewater organic constituents despite having used best good faith efforts to analyze for such constituents. I am aware that there are a significant penalties for submitting a false certification, including the possiblity of fine and imprisonment."

B.4 DECHARACTERIZED WASTE REQUIRES TREATMENT FOR UNDERLYING HAZARDOUS CONSTITUENTS
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.40 to remove the hazardous characteristic. This decharacterized waste contains underlying hazardous constituents that require further treatment to meet universal treatment standards. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

C. RESTRICTED WASTE SUBJECT TO A VARIANCE
This waste is subject to a national capacity variance, a treatability variance, or a case-by-case extension. Enter the effective date of prohibition in column 7 above.
☐ For hazardous debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

D. RESTRICTED WASTE CAN BE LAND DISPOSED WITHOUT FURTHER TREATMENT
"I have determined that this waste meets all applicable treatment standards set forth in 40 CFR Part 268 Subpart D, and all applicable prohibition levels set forth in Section 268.32 or RCRA Section 3004(d), and therefore, can be land disposed without further treatment. A copy of all applicable treatment standards and specified treatment methods is maintained at the treatment, storage and disposal facility named above." "I certify under penalty of law that I have personally examined and am familiar with the waste through analysis and testing or thorough knowledge of the waste to support this certification that the waste complies with the treatment standards specified in 40 CFR Part 268 Subpart D and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA Section 3004(d). I believe that the information I submitted is true, accurate and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment."

E. WASTE IS NOT CURRENTLY SUBJECT TO PART 268 RESTRICTIONS
This waste is a newly identified waste that is not currently subject to any 40 CFR Part 268 restrictions.

I hereby certify that all information in this and all associated documents is complete and accurate, to the best of my knowledge and information.

Signature [signature]

Title ENVIRONMENTAL COORDINATOR Date 7/30/98

GENERATOR COPY

Waste Management, Inc.
Kettleman Hills Facility
P.O. Box 471
Kettleman City, California 93239
209/386-9711

RECEIVED
SEP 22 1998
LICENSING

September 17,1998

Paul Englert
Environmental Coordinator
GENERAL ATOMICS
P.O. BOX 85608
San Diego, Ca. 92186-5608

Dear Mr. Paul Englert:

On August 6, 1998 Chemical Waste Management received manifest 98329695 EPA ID # CAD 007 638 957. This waste is currently being stored at our facility and will be shipped to Port Arthur, Texas at a later date for final destruction by incineration according to the Toxic Substances Control Act (TSCA) and Resource Conservation and Recovery Act (RCRA) regulations. A certificate of disposal will be issued to your company upon destruction of the waste.

Sincerely,

Tracy Reddick

Tracy Reddick
EMD Clerk

CC: EMD File

State of California—Environmental Protection Agency
Form Approved OMB No. 2050-0039 (Expires 9-30-99)
Please print or type. *Form designed for use on elite (12-pitch) typewriter.*

See Instructions on back of page 6.

Department of Toxic Substances Control
Sacramento, California

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No.: CAD067638957 — Manifest Document No.: 58129
2. Page 1 of 1

Information in the shaded areas is not required by Federal law.

A. State Manifest Document Number: 98329697

3. Generator's Name and Mailing Address:
GENERAL ATOMICS
ATTENTION "LSNC"
3550 GENERAL ATOMICS COUR
SAN DIEGO CA 92121

B. State Generator's ID

4. Generator's Phone (619) 455-2466

5. Transporter 1 Company Name: ADVANCED ENVIR TECH SRVS(AETS)
6. US EPA ID Number: NJD080631369

C. State Transporter's ID
D. Transporter's Phone (973) 347-7111

7. Transporter 2 Company Name: STURGEON AND SON, INC.
8. US EPA ID Number: CAD004778742

E. State Transporter's ID
F. Transporter's Phone (805) 322-4408

9. Designated Facility Name and Site Address:
ADVANCED ENVIRONMENTAL TECHNICAL SERVICES
1125 HENSLEY STREET
RICHMOND, CA 94801

10. US EPA ID Number: CAT080014079

G. State Facility's ID
H. Facility's Phone (800) 243-2382

11. US DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a. RQ HAZARDOUS WASTE, LIQUID, n.o.s. (LEAD,CHROMIUM) 9,NA3082,III (D008)	012	DF	04250	P	State 342 EPA/Other D008
b. RQ HAZARDOUS WASTE, LIQUID, n.o.s. (LEAD,CHROMIUM) 9,NA3082,III (D008)	002	DF	00080	P	State 342 EPA/Other D008
c.					State EPA/Other
d.					State EPA/Other

J. Additional Descriptions for Materials Listed Above
A)329031 TWILIQ003 12X55DF
B)329031 TWILIQ003 1X5DF

K. Handling Codes for Wastes Listed Above
a. b. c. d.

15. Special Handling Instructions and Additional Information
PACKING SLIPS ATTACHED FOR CLARIFICATION EMERGENCY PHONE 888 353-2387
C.D. REQUIRED
AETS/CA

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: Peter Engler[illegible] — Signature: [signature] — Month 07 Day 30 Year 9

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: MATT [illegible] — Signature: [signature] — Month 07 Day 30 Year 9

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name — Signature — Month Day Year

GENERATOR / TRANSPORTER / FACILITY

98329697 IN CASE OF EMERGENCY OR SPILL, CALL THE NATIONAL RESPONSE CENTER 1-800-424-8802; WITHIN CALIFORNIA, CALL 1-800-852-7550

DO NOT WRITE BELOW THIS LINE.

DTSC 8022A (4/97)
EPA 8700—22

Yellow: GENERATOR RETAINS

Waste Management

AETS/CWM

LAND DISPOSAL NC CATION AND CERTIFICATION FORM

Generator Name: General Atomics EPA ID # CAD067638957 State Manifest No. 98329697

1. If waste is a wastewater (see 40 CFR 268.2) place "w" next to the applicable code(s)
2. If waste is subject to any California List restriction enter the letter from below next to each restriction that is applicable. __ HOC, __ PCBs, __ Metals __ Acid

3. CODES WITH SUBCATEGORIES (place appropriate letter from section 9 before each code that applies) (See 40 CFR 268 for details)

___ D001 Hi-TOC	___ D003 Unexp Ord. Emg	___ K006 Hydrated	___ P047 Salts	___ P092 Hi Inc//RMERC Res.
___ D001 < 10% TOC-CWA	___ D003 Other Reactives	___ K006 Anhydrous	___ P047 Nonsalts	___ U151 Lo RMERC Res.
___ D001 < 10% TOC-Non/CWA	___ D006 Batteries	___ K069 Calcium Sulfate	___ P065 Lo Inc. Res.	___ U151 Lo Not RMERC Res.
___ D002 Non-CWA	___ D008 Lead acid batteries	___ K069 Not Calcium Sulfate	___ P065 Lo RMERC Res.	___ U151 Hi Hg
___ D002 CWA	___ D009 Organic Hg > 260ppm	___ K071 Rmerc Res.	___ P065 Not Inc./RMERC Res.	___ U240 2, 4 D
___ D003 Reactive Cyanide	___ D009 Inorg. Hg > 260	___ K071 Not Rmerc Res.	___ P065 Hi Inc./RMERC Res.	___ U240 2, 4 esters & Salts
___ D003 Reactive Sulfide	___ D009 Hg < 260	___ K106 Lo Rmerc Res.	___ P092 Lo Inc. Res.	
___ D003 Explosive	___ F025 Light ends	___ K106 Not Rmerc Res.	___ P092 Lo RMERC Res.	
___ D003 Water Reactives	___ F025 Spent filter	___ K106 > 260 ppm Hg	___ P092 Not Inc/RMERC Res.	

The subcategory for D018-D043 waste is "treated in nonCWA/nonSDWA facility" unless the following box is checked: ☐ "treated in CWA/SDWA facility"

4. COMMON CODES (Place appropriate letter from section 9 before each code that applies)

___ D004	___ D005	___ D006	A D007	A D008	___ D009	___ D010	___ D011	___ D012	___ D013	___ D014	___ D015	___ D016	___ D017	___ D018	___ D0
___ D020	___ D021	___ D022	___ D023	___ D024	___ D025	___ D026	___ D027	___ D028	___ D029	___ D030	___ D031	___ D032	___ D033	___ D034	___ D0
___ D036	___ D037	___ D038	___ D039	___ D040	___ D041	___ D042	___ D043	___ F001	___ F002	___ F003	___ F004	___ F005	___ U002	___ U003	___ U0
___ U007	___ U044	___ U061	___ U072	___ U080	___ U108	___ U117	___ U122	___ U123	___ U136	___ U154	___ U188	___ U213	___ U220	___ U226	___ U2
___ P012	___ P030	___ P051	___ P098	___ P105	___ P205	___ F006	___ F007	___ F008	___ F009	___ F010	___ F011	___ F012	___ F019	___ F039	___ K0

ADDITIONAL CODES (Enter all codes not identified above which are associated with waste)

5. USEPA HAZARDOUS WASTE CODE(S)	6. TREATMENT STANDARDS FOR NON-PHASE II STATES (INDICATE THE APPLICABLE TREATMENT STANDARD 268.41, 268.43 OR SPECIFIED TECHNOLOGY BELOW)	7. HOW MUST THE WASTE BE MANAGED? ENTER THE LETTER FROM BELOW

To identify F039, or UHCs managed in non-CWA, use the "F039/Underlying Hazardous Constituents Form" provided (CWM-2004) and check here: ☐
If no UHCs are present upon generation check here: ☒ Check here if disposal facility will check for all UHCs ☐ (i.e. no UHC form required)
To list additional EPA waste code(s), use the supplemental sheet and check here: ☐ In lieu of supplemental sheet you may use multiple copies of this form.

8. SOLVENT CONSTITUENTS (F001 - F005) Check here if disposal facility will check for all spent solvents ___

___ Acetone	___ Benzene	___ n-Butyl alcohol	___ Carbon disulfide
___ Carbon Tetrachloride	___ Chlorobenzene	___ O-Cresol	___ Cresols (m&p)
___ Cyclohexanone	___ o-Dichlorobenzene	___ 2-Ethoxyethanol	___ Ethyl acetate
___ Ethyl benzene	___ Ethyl ether	___ Isobutanol	___ Methanol
___ Methylene chloride	___ Methyl ethyl ketone	___ Methyl isobutyl ketone	___ Nitrobenzene
___ 2-Nitropropane	___ Pyridine	___ Tetrachloroethylene	___ Toluene
___ 1,1,1 Trichloroethane	___ 1, 1, 2-Trichloroethane	___ 1, 1, 2-Trichloro, 1, 2, 2-trifluoroethane	___ Trichloroethylene
___ Trichloromonofluoromethane	___ Xylenes		

9. (States authorized by EPA to manage the LDR program may have regulatory citations different from the 40 CFR citations listed below. Where these regulatory citations differ, your certification will be deemed to refer to those state citations instead of the 40 CFR citations.)

A. Or ✓ RESTRICTED WASTE REQUIRES TREATMENT
This waste must be treated to the applicable treatment standards set forth in 40 CFR Part 268 Subpart D, 268.32, or RCRA Section 3004(d)
☐ For Hazardous Debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

B.1 RESTRICTED WASTE TREATMENT TO PERFORMANCE STANDARDS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the treatment process has been operated and maintained properly so as t comply with the performance levels specified in 40 CFR Part 268, Subpart D, and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA section 3004(d) without impermissible dilution of the prohibited waste. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.2 RESTRICTED WASTES FOR WHICH THE TREATMENT STANDARD IS EXPRESSED AS A SPECIFIED TECHNOLOGY (AND THE WASTE HAS BEEN TREATED BY THAT TECHNOLOGY)
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.42. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.3 GOOD FAITH AND ANALYTICAL CERTIFICATION - FOR INCINERATED ORGANICS
"I certify under penalty of law that I have personally examined and am familiar with the treatment technology and operation of the treatment process used to support this certification and that, based on my inquiry of those individuals immediately responsible for obtaining this information, I believe that the nonwastewater organic constituents have been treated by incineration in units operated in accordance with 40 CFR Part 264, Subpart O, or 40 CFR Part 265, Subpart O, or by combustion in fuel substitution units operating in accordance with applicable technical requirements, and I have been unable to detect the nonwastewater organic constituents despite having used best good faith efforts to analyze for such constituents. I am aware that there are a significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

B.4 DECHARACTERIZED WASTE REQUIRES TREATMENT FOR UNDERLYING HAZARDOUS CONSTITUENTS
"I certify under penalty of law that the waste has been treated in accordance with the requirements of 40 CFR 268.40 to remove the hazardous characteristic. This decharacterized waste contains underlying hazardous constituents that require further treatment to meet universal treatment standards. I am aware that there are significant penalties for submitting a false certification, including the possibility of fine and imprisonment."

C. RESTRICTED WASTE SUBJECT TO A VARIANCE
This waste is subject to a national capacity variance, a treatability variance, or a case-by-case extension. Enter the effective date of prohibition in column 7 above.
☐ For hazardous debris: "This hazardous debris is subject to the alternative treatment standards of 40 CFR Part 268.45."

D. RESTRICTED WASTE CAN BE LAND DISPOSED WITHOUT FURTHER TREATMENT
"I have determined that this waste meets all applicable treatment standards set forth in 40 CFR Part 268 Subpart D, and all applicable prohibition levels set forth in Section 268.32 or RCRA Section 3004(d), and therefore, can be land disposed without further treatment. A copy of all applicable treatment standards and specified treatment methods is maintained at the treatment storage and disposal facility named above." "I certify under penalty of law that I have personally examined and am familiar with the waste through analysis and testing or thorough knowledge of the waste to support this certification that the waste complies with the treatment standards specified in 40 CFR Part 268 Subpart D and all applicable prohibitions set forth in 40 CFR 268.32 or RCRA Section 3004(d). I believe that the information I submitted is true, accurate and complete. I am aware that there are significant penalties for submitting a false certification, including the possibility of a fine and imprisonment."

E. WASTE IS NOT CURRENTLY SUBJECT TO PART 268 RESTRICTIONS
This waste is a newly identified waste that is not currently subject to any 40 CFR Part 268 restrictions.

I hereby certify that all information in this and all associated documents is complete and accurate, to the best of my knowledge and information.

Signature [signature]

Title ENVIRONMENTAL COORDINATOR Date 7/30/98

GENERATOR COPY

EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055414
Client Sample: 33921

SAMPLE ANALYSIS SUMMARY REPORT

Ionics Project: 98-1424
Ionics Sample: 14-24-1

Specific analytes	Sample		Blank	Lab spike		
	Conc (ppt)	DL (ppt)	Conc (ppt)	Conc (ppt)	Rec (%)	QC limits
2,3,7,8-TCDD	ND	0.18	ND	25.80	104%	50-150
1,2,3,7,8-PeCDD	ND	0.15	ND	51.80	83%	50-150
1,2,3,4,7,8-HxCDD	ND	0.21	ND	80.38	129%	50-150
1,2,3,6,7,8-HxCDD	ND	0.20	ND	81.80	131%	50-150
1,2,3,7,8,9-HxCDD	ND	0.19	ND	77.68	124%	50-150
1,2,3,4,6,7,8-HpCDD	ND	0.42	ND	52.80	84%	50-150
OCDD	ND	0.57	ND	123.88	124%	50-150
2,3,7,8-TCDF	ND	0.06	ND	25.67	103%	50-150
1,2,3,7,8-PeCDF	ND	0.07	ND	49.77	80%	50-150
2,3,4,7,8-PeCDF	ND	0.08	ND	55.19	88%	50-150
1,2,3,4,7,8-HxCDF	ND	0.36	ND	78.67	126%	50-150
1,2,3,6,7,8-HxCDF	ND	0.33	ND	72.82	117%	50-150
2,3,4,6,7,8-HxCDF	ND	0.41	ND	78.41	125%	50-150
1,2,3,7,8,9-HxCDF	ND	0.41	ND	78.51	126%	50-150
1,2,3,4,6,7,8-HpCDF	ND	0.49	ND	73.31	117%	50-150
1,2,3,4,7,8,9-HpCDF	ND	0.58	ND	58.43	93%	50-150
OCDF	ND	0.54	ND	143.28	143%	50-150

Total analytes*	Number	Conc (ppt)	DL (ppt)	
TOTAL TCDD	0	ND	0.18	Total dioxins/furans
TOTAL PeCDD	0	ND	0.15	
TOTAL HxCDD	0	ND	0.21	ND
TOTAL HpCDD	0	ND	0.42	
TOTAL TCDF	0	ND	0.06	2,3,7,8-TCDD toxicity equivalent
TOTAL PeCDF	0	ND	0.08	
TOTAL HxCDF	0	ND	0.41	ND
TOTAL HpCDF	0	ND	0.55	

*Includes non-specific analytes, in addition to those chlorinated at carbon atoms 2, 3, 7, and 8.

EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055414 | **BLANK ANALYSIS REPORT** | **Ionics Project: 98-1424**
Client Sample: Method Blank | **Ionics Sample: DFBLK 84-079**

Date extracted:	5/13/98	Sample size:	1 L	File:	A11520
Date analyzed:	5/19/98	Matrix:	Water	Ref check:	A11517
				Daily cal:	A11517
				Initial cal:	A050797

Specific analytes	Conc (ppt)	DL (ppt)	Ratio	RT (min)	Flags
2,3,7,8-TCDD	ND	0.03	-	-	U
1,2,3,7,8-PeCDD	ND	0.05	-	-	U
1,2,3,4,7,8-HxCDD	ND	0.16	-	-	U
1,2,3,6,7,8-HxCDD	ND	0.15	-	-	U
1,2,3,7,8,9-HxCDD	ND	0.14	-	-	U
1,2,3,4,6,7,8-HpCDD	ND	0.19	-	-	U
OCDD	ND	0.51	-	-	U
2,3,7,8-TCDF	ND	0.03	-	-	U
1,2,3,7,8-PeCDF	ND	0.04	-	-	U
2,3,4,7,8-PeCDF	ND	0.04	-	-	U
1,2,3,4,7,8-HxCDF	ND	0.14	-	-	U
1,2,3,6,7,8-HxCDF	ND	0.11	-	-	U
2,3,4,6,7,8-HxCDF	ND	0.13	-	-	U
1,2,3,7,8,9-HxCDF	ND	0.15	-	-	U
1,2,3,4,6,7,8-HpCDF	ND	0.23	-	-	U
1,2,3,4,7,8,9-HpCDF	ND	0.27	-	-	U
OCDF	ND	0.67	-	-	U

Total analytes*	Number	Conc (ppt)	DL (ppt)	Flags
TOTAL TCDD	0	ND	0.03	-
TOTAL PeCDD	0	ND	0.05	-
TOTAL HxCDD	0	ND	0.16	-
TOTAL HpCDD	0	ND	0.19	-
TOTAL TCDF	0	ND	0.03	-
TOTAL PeCDF	0	ND	0.04	-
TOTAL HxCDF	0	ND	0.15	-
TOTAL HpCDF	0	ND	0.27	-

*Includes non-specific analytes, in addition to those chlorinated at carbon atoms 2, 3, 7, and 8.

EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055493
Client Sample: 34276

SAMPLE ANALYSIS SUMMARY REPORT

Ionics Project: 98-1424
Ionics Sample: 14-24-2

Specific analytes	Sample		Blank	Lab spike		
	Conc (ppt)	DL (ppt)	Conc (ppt)	Conc (ppt)	Rec (%)	QC limits
2,3,7,8-TCDD	ND	0.12	ND	25.90	104%	50-150
1,2,3,7,8-PeCDD	ND	0.05	ND	51.80	83%	50-150
1,2,3,4,7,8-HxCDD	ND	0.06	ND	80.36	129%	50-150
1,2,3,6,7,8-HxCDD	ND	0.06	ND	81.60	131%	50-150
1,2,3,7,8,9-HxCDD	ND	0.06	ND	77.68	124%	50-150
1,2,3,4,6,7,8-HpCDD	ND	0.30	ND	52.80	84%	50-150
OCDD	ND	0.12	ND	123.88	124%	50-150
2,3,7,8-TCDF	ND	0.08	ND	25.67	103%	50-150
1,2,3,7,8-PeCDF	ND	0.13	ND	49.77	80%	50-150
2,3,4,7,8-PeCDF	ND	0.14	ND	55.19	88%	50-150
1,2,3,4,7,8-HxCDF	ND	0.24	ND	78.67	126%	50-150
1,2,3,6,7,8-HxCDF	ND	0.22	ND	72.82	117%	50-150
2,3,4,6,7,8-HxCDF	ND	0.27	ND	78.41	125%	50-150
1,2,3,7,8,9-HxCDF	ND	0.27	ND	78.51	126%	50-150
1,2,3,4,6,7,8-HpCDF	ND	0.28	ND	73.31	117%	50-150
1,2,3,4,7,8,9-HpCDF	ND	0.32	ND	58.43	93%	50-150
OCDF	ND	0.13	ND	143.28	143%	50-150

Total analytes*	Number	Conc (ppt)	DL (ppt)
TOTAL TCDD	0	ND	0.12
TOTAL PeCDD	0	ND	0.05
TOTAL HxCDD	0	ND	0.06
TOTAL HpCDD	0	ND	0.30
TOTAL TCDF	0	ND	0.08
TOTAL PeCDF	0	ND	0.14
TOTAL HxCDF	0	ND	0.27
TOTAL HpCDF	0	ND	0.32

Total dioxins/furans

ND

2,3,7,8-TCDD toxicity equivalent

ND

*Includes non-specific analytes, in addition to those chlorinated at carbon atoms 2, 3, 7, and 8.

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EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055414
Client Sample: Method Blank

BLANK ANALYSIS REPORT

Ionics Project: 98-1424
Ionics Sample: DFBLK B4-079

Date extracted:	5/13/98	Sample size:	1 L	File:	A11520
Date analyzed:	5/19/98	Matrix:	Water	Ret check:	A11517
				Daily cal:	A11517
				Initial cal:	A050797

Specific analytes	Conc (ppt)	DL (ppt)	Ratio	RT (min)	Flags
2,3,7,8-TCDD	ND	0.03	-	-	U
1,2,3,7,8-PeCDD	ND	0.05	-	-	U
1,2,3,4,7,8-HxCDD	ND	0.16	-	-	U
1,2,3,6,7,8-HxCDD	ND	0.15	-	-	U
1,2,3,7,8,9-HxCDD	ND	0.14	-	-	U
1,2,3,4,6,7,8-HpCDD	ND	0.19	-	-	U
OCDD	ND	0.51	-	-	U
2,3,7,8-TCDF	ND	0.03	-	-	U
1,2,3,7,8-PeCDF	ND	0.04	-	-	U
2,3,4,7,8-PeCDF	ND	0.04	-	-	U
1,2,3,4,7,8-HxCDF	ND	0.14	-	-	U
1,2,3,6,7,8-HxCDF	ND	0.11	-	-	U
2,3,4,6,7,8-HxCDF	ND	0.13	-	-	U
1,2,3,7,8,9-HxCDF	ND	0.15	-	-	U
1,2,3,4,6,7,8-HpCDF	ND	0.23	-	-	U
1,2,3,4,7,8,9-HpCDF	ND	0.27	-	-	U
OCDF	ND	0.67	-	-	U

Total analytes*	Number	Conc (ppt)	DL (ppt)	Flags
TOTAL TCDD	0	ND	0.03	-
TOTAL PeCDD	0	ND	0.05	-
TOTAL HxCDD	0	ND	0.16	-
TOTAL HpCDD	0	ND	0.19	-
TOTAL TCDF	0	ND	0.03	-
TOTAL PeCDF	0	ND	0.04	-
TOTAL HxCDF	0	ND	0.15	-
TOTAL HpCDF	0	ND	0.27	-

*Includes non-specific analytes, in addition to those chlorinated at carbon atoms 2, 3, 7, and 8.

EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055493
Client Sample: 34276

SAMPLE ANALYSIS REPORT

Ionics Project: 98-1424
Ionics Sample: 14-24-2

Date collected:	4/29/98	Sample size:	0.835 L	File:	A11524
Date received:	5/11/98	Matrix:	Water	Ret check:	A11517
Date extracted:	5/13/98	Origin:	EMSL	Daily cal:	A11517
Date analyzed:	5/19/98			Initial cal:	A050797

Specific analytes	Conc (ppt)	DL (ppt)	Ratio	RT (min)	Flags
2,3,7,8-TCDD	ND	0.12	-	00:00	U
1,2,3,7,8-PeCDD	ND	0.05	-	00:00	U
1,2,3,4,7,8-HxCDD	ND	0.06	-	00:00	U
1,2,3,6,7,8-HxCDD	ND	0.06	-	00:00	U
1,2,3,7,8,9-HxCDD	ND	0.06	-	00:00	U
1,2,3,4,6,7,8-HpCDD	ND	0.30	-	00:00	U
OCDD	ND	0.12	-	00:00	U
2,3,7,8-TCDF	ND	0.06	-	00:00	U
1,2,3,7,8-PeCDF	ND	0.13	-	00:00	U
2,3,4,7,8-PeCDF	ND	0.14	-	00:00	U
1,2,3,4,7,8-HxCDF	ND	0.24	-	00:00	U
1,2,3,6,7,8-HxCDF	ND	0.22	-	00:00	U
2,3,4,6,7,8-HxCDF	ND	0.27	-	00:00	U
1,2,3,7,8,9-HxCDF	ND	0.27	-	00:00	U
1,2,3,4,6,7,8-HpCDF	ND	0.28	-	00:00	U
1,2,3,4,7,8,9-HpCDF	ND	0.32	-	00:00	U
OCDF	ND	0.13	-	00:00	U

Total analytes*	Number	Conc (ppt)	DL (ppt)	Flags
TOTAL TCDD	0	ND	0.12	U
TOTAL PeCDD	0	ND	0.05	U
TOTAL HxCDD	0	ND	0.06	U
TOTAL HpCDD	0	ND	0.30	U
TOTAL TCDF	0	ND	0.06	U
TOTAL PeCDF	0	ND	0.14	U
TOTAL HxCDF	0	ND	0.27	U
TOTAL HpCDF	0	ND	0.32	U

*Includes non-specific analytes, in addition to those chlorinated at carbon atoms 2, 3, 7, and 8.

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EMSL Analytical, Inc.

ANALYSIS OF POLYCHLORINATED DIOXINS/FURANS BY METHOD 8280

Client Project: 98055493
Client Sample: 34276

SAMPLE ANALYSIS
TEF REPORT

Ionics Project: 98-1424
Ionics Sample: 14-24-2

Date collected:	4/29/98	Sample size:	0.835 L	File:	A11524
Date received:	5/11/98	Matrix:	Water	Rt check:	A11517
Date extracted:	5/13/98	Origin:	EMSL	Daily cal:	A11517
Date analyzed:	5/19/98			Initial cal:	A050797

Specific analytes	Conc (ppt)		TEF		TEQ (ppt)
2,3,7,8-TCDD	ND	x	1.000	=	-
1,2,3,7,8-PeCDD	ND	x	0.500	=	-
1,2,3,4,7,8-HxCDD	ND	x	0.100	=	-
1,2,3,6,7,8-HxCDD	ND	x	0.100	=	-
1,2,3,7,8,9-HxCDD	ND	x	0.100	=	-
1,2,3,4,6,7,8-HpCDD	ND	x	0.010	=	-
OCDD	ND	x	0.001	=	-
2,3,7,8-TCDF	ND	x	0.100	=	-
1,2,3,7,8-PeCDF	ND	x	0.050	=	-
2,3,4,7,8-PeCDF	ND	x	0.500	=	-
1,2,3,4,7,8-HxCDF	ND	x	0.100	=	-
1,2,3,6,7,8-HxCDF	ND	x	0.100	=	-
2,3,4,6,7,8-HxCDF	ND	x	0.100	=	-
1,2,3,7,8,9-HxCDF	ND	x	0.100	=	-
1,2,3,4,6,7,8-HpCDF	ND	x	0.010	=	-
1,2,3,4,7,8,9-HpCDF	ND	x	0.010	=	-
OCDF	ND	x	0.001	=	-

Total 2,3,7,8-TCDD toxicity equivalent (1989 ITEF): ND

Not all of the analytes have the same degree of toxicity, so it is convenient to express the toxicity of a sample as its equivalent 2,3,7,8-TCDD content. The concentration of each analyte is multiplied by the appropriate Toxicity Equivalence Factor (TEF), and the individual results of these calculations are summed to afford the 2,3,7,8-TCDD toxicity equivalent.

The 1989 International Toxicity Equivalence Factors are employed during these calculations.

ATTACHMENT IV

2746001 N/C

GENERAL ATOMICS
PROPRIETARY DATA

SUPERCRITICAL WATER OXIDATION TREATABILITY TESTING OF SEWAGE SLUDGE

TEST REPORT

WORK PERFORMED FOR THE CITY OF DAYTON, OHIO UNDER THE DIRECTION OF BLACK & VEATCH

PROJECT 2746

SEPTEMBER 1998

EXECUTIVE SUMMARY

The City of Dayton is in the process of closing eight sludge storage lagoons located at its wastewater treatment plant. Five of the lagoons are contaminated with polychlorinated biphenyl (PCB) compounds which will require treatment to ensure PCB destruction. The City of Dayton has been evaluating non-incineration technologies for application to PCB destruction and has selected supercritical water oxidation (SCWO) for further evaluation. General Atomics (GA) performed pilot-scale SCWO testing on sewage sludge provided by Dayton using two feeds: (1) non-contaminated sludge, spiked with a PCB simulant (chlorobenzene), to be used to verify SCWO system operation prior to testing with actual PCB-contaminated sludge, and (2) PCB-contaminated sludge. Testing of the non-contaminated sludge was performed without incident with excellent pressure control and chlorobenzene destruction in excess of 99.999%. Testing with the PCB-contaminated sludge, however, showed the sludge to be significantly more abrasive than the non-contaminated material, resulting in excessive wear of the pressure letdown system and loss of pressure control. Liquid effluent samples were collected for analysis prior to the loss of pressure control and subsequent termination of the test. No PCBs were detected in these effluent samples. The pressure letdown system was then modified to match our standard configuration for abrasive feeds, a configuration initially considered unnecessary. Testing with PCB-contaminated sludge was then resumed. Sludge was fed at a rate of 0.65 kg/min for approximately 2 hours with a solids concentration of 13 wt%. No feed problems occurred, and pressure and temperature control were excellent. One PCB, PCB 1260, was detected in one liquid effluent sample at a concentration of 5.9 ppb, corresponding to a destruction and removal efficiency of 99.997%. Later analysis of a baseline sample taken prior to the start of this test showed the concentration of PCB 1260 to be 80.4 ppb, thus showing that the SCWO system had been contaminated due to the unplanned termination of the initial test. The liquid effluent also contained 72 ppm of Cr^{+6}, which is thought to have come from abrasion of unprotected alloy tubing in the GA pilot plant. Analyses showed 0.026 to 0.048 ppt total dioxins/furans in the gas, well below allowable limits for a full-scale facility operated in the State of Ohio.

Overall, the tests successfully demonstrated the complete destruction of PCBs in the sludge (except for trace system contamination). When modifications were made to accommodate the abrasive solids, the SCWO pilot plant operated reliably, with no significant pressure or temperature fluctuations and no process upsets. Future process upgrades were identified to further improve performance and reliability and to ensure complete removal of dioxins and furans from the gaseous effluent and Cr^{+6} from the liquid effluent.

A budgetary estimate for a full-scale SCWO system for destruction of the Dayton lagooned sludge over a period of 12 years is provided, together with assumptions and economic evaluations.

1. INTRODUCTION AND PURPOSE

The City of Dayton is in the process of closing eight sludge storage lagoons located at its wastewater treatment plant. Five of the lagoons are contaminated with polychlorinated biphenyl (PCB) compounds which will require treatment to ensure PCB destruction. The City of Dayton, through its engineering consultant Black & Veatch, has been evaluating non-incineration technologies for application to PCB destruction and has selected supercritical water oxidation (SCWO) for further evaluation. General Atomics (GA) was selected to perform pilot-scale testing of the SCWO treatment of PCB-contaminated Dayton sewage sludge to determine the overall effectiveness of the SCWO process. As required by the Toxic Substances Control Act (TSCA), SCWO must provide equal or better PCB destruction, relative to incineration, in order to be considered an alternative destruction process.

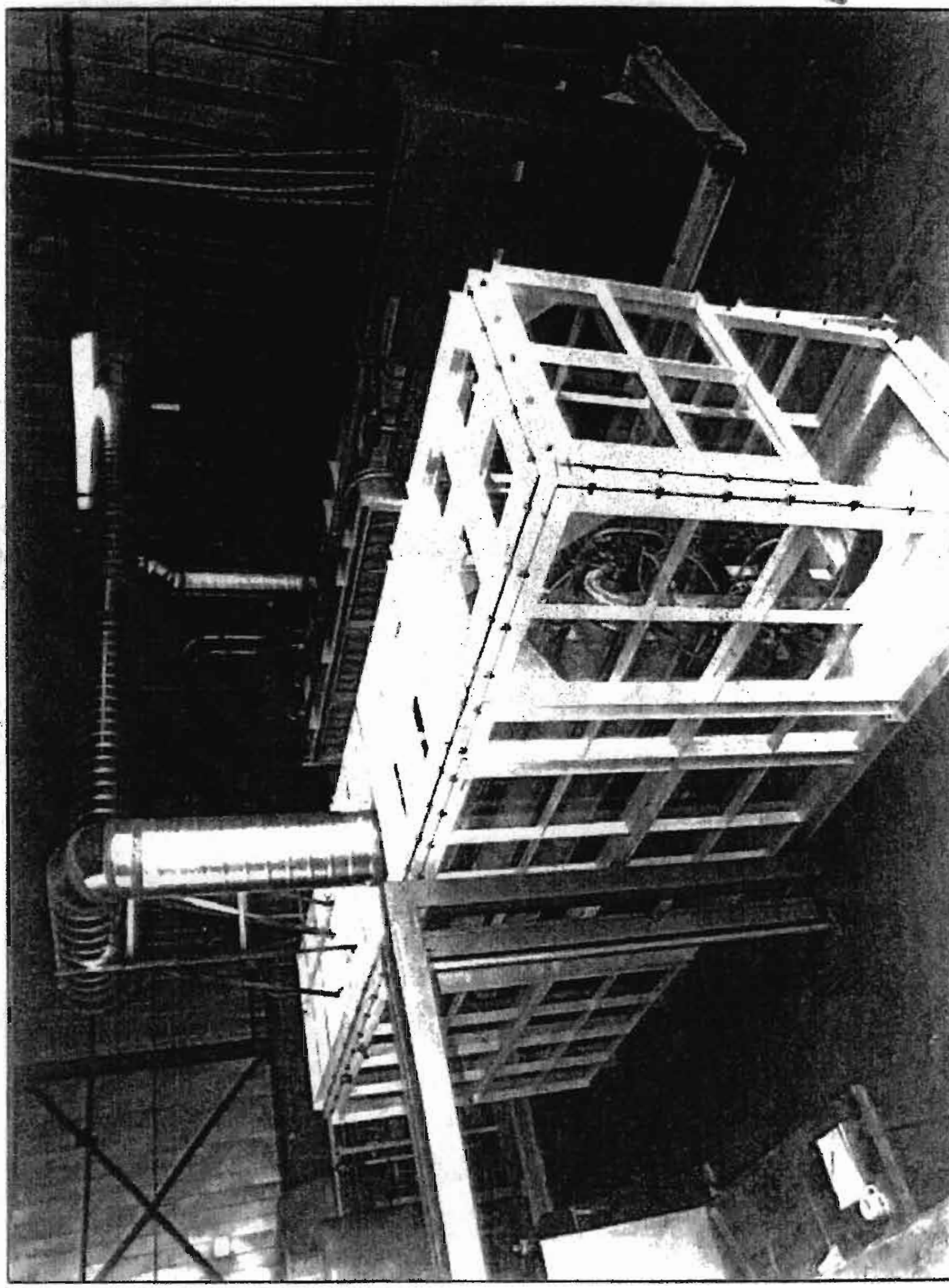
Sludge testing was performed in two phases: (1) processing of non-contaminated sludge, spiked with a suitable PCB simulant and (2) processing of PCB-contaminated sludge. The PCB simulant selected for use was chlorobenzene.

2. PILOT TESTING EQUIPMENT AND CONFIGURATION

Testing was performed in the GA SCWO pilot plant located in Building 36 of the GA site. The pilot plant consists of a series of integrated skid-mounted subsystems. The subsystems used during testing were the feed skid, the mix tank skid, the reactor skid, and the compressor skid. Additionally, a liquid effluent collection and sampling station was used as well as the pilot plant control room which contains all computer control and data logging components and the gas sampling and analysis equipment. Figure 1 shows a photograph of the reactor skid, and Fig. 2 shows a simplified process flow diagram for the pilot plant, as configured for SCWO testing of PCB-contaminated sludge.

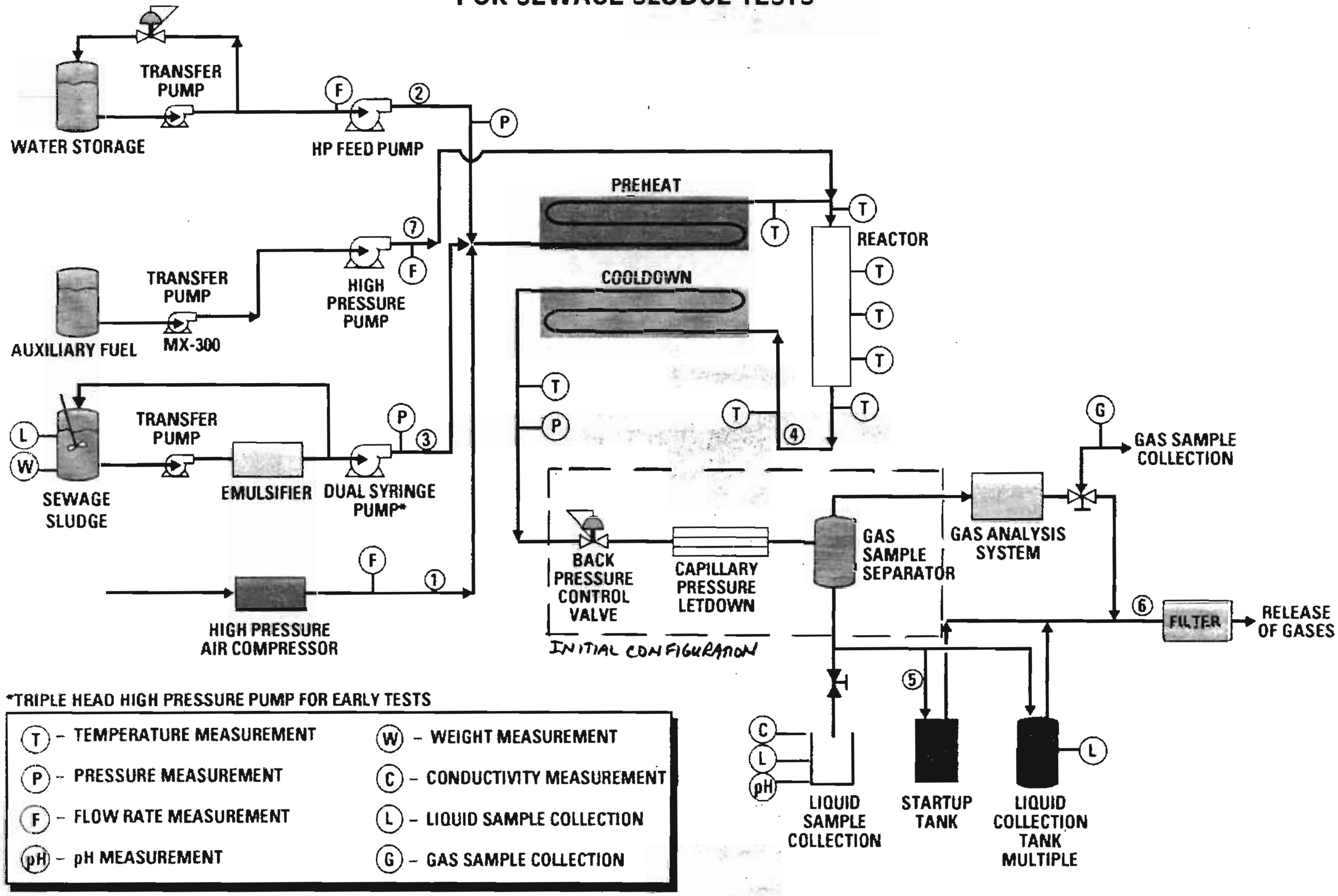
The feed skid contains a series of ventilated enclosures for controlled containment and segregation of the various feeds. The feeds utilized during this test program were ethanol auxiliary fuel, non-contaminated sludge (received from the City of Dayton and spiked with

FIGURE 1
PILOT PLANT REACTOR SKID



L-947(45)
12-9-97

FIGURE
PROCESS FLOW DIAGRAM FOR SEWAGE SLUDGE TESTS



2746001 N/C

chlorobenzene as the PCB simulant), and PCB-contaminated sludge (also received from the City of Dayton).

The mix tank skid includes a high pressure feed pump that was used for ethanol feed during testing.

The reactor skid houses all high temperature pilot plant components and is fitted with impact-resistant Lexan shielding for personnel protection. The main components within the skid include high-pressure pumps, electric heaters for preheating the reactor and feed, reactor, heat exchangers for process effluent cooldown, and a pressure letdown system.

The air compressor skid is located outside of the pilot plant building and is rated at approximately 80 scfm @ 5000 psig.

The effluent collection system consists of a liquid effluent sampling station and collection tank, and a gaseous effluent sampling station and vent system. The process effluent, consisting of a gas stream and a liquid/solid stream, enters the effluent collection system and is collected directly in 55-gal drums. Liquid effluent samples (with entrained solids) were routinely collected during the Dayton test program. The gaseous effluent is vented from the drum, through a charcoal filter, to the environment. The exhaust gas is continuously monitored for oxygen, carbon monoxide, and total hydrocarbon content. Gas samples were also collected for more detailed analyses during the Dayton program.

The pilot plant control system is designed to provide stable, reliable system operation and fast, safe automatic shutdown if temperatures or pressures beyond preset limits are detected. All temperature, pressure, and flow setpoint and alarm data are continuously monitored and logged at approximately 6-sec intervals. A programmable logic controller (PLC) is used to provide control and alarm/interlock functions for critical parameters.

3. PRE-TESTING OPTIMIZATION

Pre-testing optimization was performed in two areas of operations. The first concerned preliminary testing for verification of pilot plant performance and readiness prior to the start of PCB testing. The second concerned modification of the pilot plant pressure letdown system to accommodate the abrasive nature of the PCB-contaminated sludge. This modification was actually performed after an initial aborted test of the PCB-contaminated sludge.

Prior to the start of testing with Dayton sludge, GA performed testing using chlorobenzene as a PCB simulant to verify performance of the SCWO pilot plant prior to actual testing with PCBs. Two tests were performed, one using a salt feed and one using a 50/50 mixture of primary and secondary sewage sludge obtained from the Encina Wastewater Authority, located approximately 15 miles north of GA. Both of these tests utilized ethanol spiked with 1 to 2 wt% chlorobenzene as the auxiliary fuel. Typical operational temperature and pressures were 625 to 640°C and 3400 psi, with salt solution or sludge feed rates of 0.6 to 0.9 kg/min. Liquid effluent samples were collected and analyzed for chlorobenzene to determine destruction and removal efficiencies (DRE). Chlorobenzene concentrations in the effluent were measured at 0.12 to 0.14 ppb, yielding DREs in excess of 99.9999%. With good destruction of chlorobenzene observed, preparations for testing with non-contaminated Dayton sewage sludge began. This testing is described below in Section 4.

The configuration of the pilot plant shown previously in Fig. 1 used a single pressure control valve and capillary manifold to handle the multi-phase effluent stream and provide overall SCWO system pressure control. Using advanced materials for abrasion resistance, this configuration was used extensively for prior testing of a wide range of feeds including concentrated salt solutions and sludges. Other pressure control options had been previously employed for extremely abrasive feeds, but the pilot plant was not currently configured with these options which were considered unnecessary for the Dayton sludge feeds. Following completion of testing with Dayton non-contaminated sewage sludge (see Section 4), this pressure control philosophy still appeared to be sound. After testing for only a short period with the Dayton PCB-contaminated sludge, however, it became apparent that the abrasive characteristics of the PCB-contaminated sludge were significantly worse than those of the non-contaminated sludge. It therefore became necessary to modify the pilot plant to our configuration standard for abrasive feeds. This configuration employs a high pressure liquid/gas separator upstream of pressure letdown. The overall SCWO system pressure control can then be performed on the clean gas stream. Without the high gas volumes, the velocity of the liquid stream (which contains entrained solids) is significantly reduced, thus reducing abrasion. The pilot plant modifications were quickly completed, and the PCB-contaminated sludge was processed without further incident.

4. DAYTON NON-CONTAMINATED SLUDGE TESTING RESULTS

One 55-gal drum of non-contaminated sewage sludge was shipped to GA from the City of Dayton. The sludge was intended to simulate the PCB-contaminated sludge in all important respects, except for the presence of PCBs. Upon receipt, GA inspected the material, mixed it well, and collected a sample for analysis. Based on gravimetric analyses, the total solids (TS) concentration was estimated to be 23.9 wt%. Sufficient water was then added to the drum to yield a target TS concentration of approximately 10 wt%, and the sludge was blended in a commercial slurry grinder in preparation for testing. (Based on prior sludge testing at GA, sludges with 10 wt% solids can be reliably fed for extended periods of time using GA's proprietary high-pressure slurry feed system.)

A SCWO test was performed on 4/21/98. Non-contaminated sewage sludge was fed at a rate of 0.82 kg/min for approximately 2 hr. No feed problems were observed throughout the entire test period. The sludge was preheated at full operating pressure to approximately 375°C using electric heating elements to simulate heat recovery. (Because of the low heat value of the sludge, heat recovery will be necessary in any large-scale sludge processing plant to minimize auxiliary fuel requirements.) Ethanol spiked with 1 wt% chlorobenzene was used as the auxiliary fuel and fed at a rate necessary to achieve target temperatures. Two reactor temperatures were investigated to determine the effects of temperature on PCB simulant destruction. The first hour of testing was performed at 620 to 630°C, and the second hour of testing was performed at 580 to 600°C. Both tests were performed at a pressure of 3400 psi. High-pressure air was fed at about 15% excess of stoichiometric requirements, yielding effluent oxygen concentrations of ~3.4 v/o.

CO concentrations were measured by an on-line solid state CO analyzer which was not affected by the presence of N_2O, a common SCWO product. (N_2O is known to register erroneously as CO on standard infrared CO analyzers.) No CO was detected in the gaseous effluent during the higher temperature test, but CO concentrations up to approximately 15 ppm were detected during the lower temperature test. Total hydrocarbon concentrations were measured by an on-line analyzer and found to be <1 ppm throughout the test.

The SCWO effluent was a uniform tan color. After settling, the effluent was comprised of a tan solid phase and a clear but yellow-green liquid phase. Liquid effluent samples were collected throughout the test, and one sample for each of the two temperatures investigated was analyzed for chlorobenzene content. For the 620-630°C test, the chlorobenzene concentration in the effluent was measured at 0.96 μg/l, yielding a DRE of 99.9997%. For the 580-600°C test, the chlorobenzene concentration in the effluent was measured at 0.083 μg/l, yielding a DRE of 99.9998%. This test utilized a lower ethanol/chlorobenzene flow rate to maintain temperature, so the DRE was essentially the same as for the higher temperature test even though the measured chlorobenzene concentration was lower. The effluent samples were also analyzed for TS, total volatile solids (TVS), total suspended solids (TSS), volatile suspended solids (VSS), total organic carbon (TOC), and chemical oxygen demand (COD). The results of these analyses are shown in Table 1. Also included in Table 1 for comparison are the analytical results for the as-received Dayton sludge and the diluted feed used for testing.

5. DAYTON PCB-CONTAMINATED SLUDGE TESTING RESULTS

One 55-gal drum of PCB-contaminated sewage sludge was shipped to GA from the City of Dayton. As with the non-contaminated sludge, GA collected a well-mixed sample from the drum for analysis. The TS concentration was estimated to be 30.0 wt%, somewhat higher than for the simulant sludge. Sufficient water was then added to the drum to yield a TS concentration of approximately 10 wt%, and the sludge was blended in a commercial slurry grinder in

TABLE 1
LIQUID/SOLID EFFLUENT ANALYSIS RESULTS
FOR DAYTON NON-CONTAMINATED SLUDGE TESTING(1)

Component	As-Received Feed	Diluted Feed	Higher Temp. Test Effluent	Lower Temp. Test Effluent
Total Solids (TS)	21.45 %	13.7 %	3.9 %	4.1 %
Total Volatile Solids (TVS)	14 %	6.4 %	0.2 %	0.2 %
Total Suspended Solids (TSS)	18%	13.4 %	4.0 %	3.8 %
Volatile Suspended Solids (VSS)	10.6 %	6.6 %	0.08 %	0.08 %
Total Organic Carbon (TOC)	14300 mg/l	21,400 mg/l	54 mg/l	51 mg/l
Chemical Oxygen Demand (COD)	---	---	4100 mg/l	980 mg/l
Chlorobenzene Dopant(2)	---	376 ppm(3)	0.96 ppt	0.083 ppt

(1) Test performed on 4/21/98.
(2) Chlorobenzene used as PCB simulant.
(3) Based on 1 wt% chlorobenzene in ethanol solution fed at 0.032 kg/min and combined with 0.819 kg/min of sludge feed.

preparation for testing. Subsequent analysis by GA of the prepared feed material showed the TS concentration to be 13.7 wt%, slightly higher than the target value of 10 wt%. Analyses by Black & Veatch measured the TS concentration at about 13.5 wt%.

SCWO testing of the PCB-contaminated sludge began on 4/27/98. Reactor operating temperature and pressure were 630-640°C and 3400 psi. Electric preheat of the sludge to approximately 375°C was again used to simulate heat recovery. The sludge flow rate was 0.83 kg/min, the air flow rate was approximately 1.2 kg/min (~33% excess of stoichiometric), and ethanol was used to provide additional heat value to maintain temperature. Soon after testing began, it became apparent that the PCB-contaminated sludge was significantly more abrasive than the non-contaminated sludge. After only 5-10 minutes of sludge feed, excessive wear of the pressure letdown valve was evident. The valve had to close to an increasingly greater degree to maintain the 3400 psi operating pressure. (By comparison, the non-contaminated Dayton sludge was run for several hours with little or no discernible control valve wear.) While good pressure and temperature control could still be maintained, a liquid effluent sample was collected for later analysis by representatives of Black & Veatch. The feed was transitioned to water, and the SCWO system was shut down. During the transition to water and during shutdown, pressure and temperature control were difficult, and insufficient time at temperature was available to ensure residual PCB destruction from the sludge remaining in the system. Following shutdown, the pilot plant pressure letdown system was then modified to our standard configuration for abrasive feeds (see Section 3), which, based on the non-contaminated sludge results, was previously thought to be unnecessary. In this important respect, the simulant sludge had failed to adequately simulate the PCB-contaminated sludge. The modifications were completed, and testing with the PCB-contaminated sludge resumed.

Following system modifications, the final PCB-contaminated sludge test was performed on 4/29/98. Sludge was fed at a rate of 0.64 kg/min for approximately 2-1/4 hrs. GA's slurry feed system operated very smoothly over the entire test duration. Reactor operating temperature and pressure were 640-650°C and 3400 psi. Electric preheat of the sludge to approximately 375-400°C was used to simulate heat recovery. A small water flow (0.53 kg/min) was injected into the outlet of the reactor to partially cool the effluent prior to entering the cooldown heat exchangers. The air flow rate was 0.64 kg/min, ~25% excess of stoichiometric requirements (effluent oxygen concentrations of 5.3 v/o). Ethanol was again used to provide additional heat value to maintain temperature.

The test ran very smoothly. Temperature and pressure control were excellent. The modified pressure letdown system utilizing a high-pressure liquid/gas separator worked very well, as expected, and no signs of erosion of the pressure letdown system were observed. The effluent was a uniform tan color upon exiting the SCWO system, slightly darker in color than the effluent from the non-contaminated sludge test. Upon settling, the effluent consisted of an tan solid and a clear but yellow-green liquid. Liquid and gaseous effluent samples were collected throughout the run by Black & Veatch personnel for later analysis. No CO was detected in the off-gas, as measured by an on-line solid-state CO analyzer. Total hydrocarbon concentrations were measured via an on-line analyzer at approximately 5 ppm. Eight liquid samples were collected, each approximately 1 liter. The eight samples were then well mixed, and ~500-ml aliquots were transferred to a larger mixing container. The container contents were well mixed and then transferred to individual bottles for further separation and eventual shipment by Black & Veatch to an analytical laboratory. Two gas samples were collected, each over a 1-hr period. In total, nine different samples were collected, two for the initial shortened test of 4/27/98, and seven for the final test of 4/29/98. The sample designations are described below:

INF-1	Sludge feed for test of 4/27/98
WW-1	Wastewater sample (composite SCWO process effluent) from test of 4/27/98
FEED-2	Sludge feed for test of 4/29/98
WW-2	Wastewater sample (composite SCWO process effluent) from test of 4/29/98
DEC-2	Wastewater decant sample (SCWO effluent liquid fraction only) from test of 4/29/98
SD-2	Wastewater solids sample (SCWO effluent solids fraction only) from test of 4/29/98
SD-2D	Wastewater solids sample (SCWO effluent solids fraction only) from test of 4/29/98 (duplicate of SD-2)
GAS-2	Gaseous effluent sample from test of 4/29/98
GAS-2D	Gaseous effluent sample from test of 4/29/98 (duplicate of GAS-2)

Following the tests, sample analyses were performed over several months by laboratories arranged by Black & Veatch. Tables 2 and 3 show the analytical results for the liquid/solid and gaseous effluent analyses, respectively, provided to GA by Black & Veatch. For the test of 4/27, no gas samples were collected. Liquid analyses showed no PCBs, no dioxins/furans, and very low organic levels. For the test of 4/29, one PCB (PCB 1260) was detected in the liquid effluent at a concentration of 5.9 μg/l, but subsequent analysis of an effluent sample collected before the start of sludge feed (i.e., a baseline water sample) showed this same PCB at a concentration of 80.4 μg/l. Apparently, the unplanned shutdown of the test of 4/27 resulted in low-level contamination of the SCWO piping, which decayed over the course of the SCWO run. Even with this contamination, the PCB DRE was in excess of 99.99%. No dioxins/furans were detected in the liquid phase, and no PCBs were detected in the gaseous effluent. Very low levels of dioxins/furans were detected in the gas samples (<<1 ppt). Low levels of total hydrocarbons, 25-27 ppm, were measured in the off-gas, as compared to a concentration of ~5 ppm measured via an on-line analyzer. Metal analyses showed the presence of significant quantities of hexavalent chrome due to the abrasiveness of the feed. The analytical results are discussed further in Section 6.

TABLE 2
LIQUID/SOLID EFFLUENT ANALYSIS RESULTS
FOR DAYTON PCB-CONTAMINATED SLUDGE TESTING[1]

		Aborted First Run		Second Run				
Category	Component, Concentration	INF-1[2]	WW-1[3]	FEED-2[4]	WW-2[5]	DEC-2[6]	SD-2[7]	SD-2D[8]
Solids	Total Solids (TS), %	14	---	13	4.8	---	18	20
	Total Volatile Solids (TVS), %	---	---	---	2.4	---	---	---
	Total Suspended Solids (TSS), %	---	---	---	3.9	---	---	---
	Volatile Suspended Solids (VSS), %	---	---	---	0.05	---	---	---
PCBs/Dioxins/Furans	PCB 1016, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1221, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1232, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1242, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1248, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1254, μg/l	---	<0.5	---	<0.5	---	---	---
	PCB 1260, μg/l	---	<0.5	---	5.9	---	---	---
	Total Dioxins/Furans, ppt	---	None Detected[9]	---	None Detected[10]	---	---	---
	2,3,7,8-TCDD Toxicity Equivalent, ppt	---	None Detected[9]	---	None Detected[10]	---	---	---
Semivolatile Organics	Numerous Species[11], μg/l	---	---	---	None Detected[11]	---	---	---
Volatile Organics	Numerous Species[12], μg/l	---	Note 12	---	---	---	---	---
	Methylene Chloride, μg/l	---	1[13]	---	---	---	---	---
	Benzene, μg/l	---	3	---	---	---	---	---
	Toluene, μg/l	---	2	---	---	---	---	---
TOC/COD/Nitrogen	Total Organic Carbon (TOC), mg/l	---	<1.0	---	---	<1.0	---	---
	Chemical Oxygen Demand (COD), mg/l	---	---	---	---	<10	---	---
	Ammonia Nitrogen, mg/l	---	---	---	---	<0.5	---	---
TCLP Metals	Arsenic (As), mg/l	---	---	---	---	---	<2.5	<2.5
	Barium (Ba), mg/l	---	---	---	---	---	<1.0	<1.0
	Cadmium (Cd), mg/l	---	---	---	---	---	1.2	1.4
	Chromium (Cr), mg/l	---	---	---	---	---	1.4	1.4
	Lead (Pb), mg/l	---	---	---	---	---	<1.0	<1.0
	Mercury (Hg), mg/l	---	---	---	---	---	0.0068	0.0066
	Selenium (Se), mg/l	---	---	---	---	---	<1.0	<1.0
	Silver (Ag), mg/l	---	---	---	---	---	<0.25	<0.25

TABLE 2 (Cont'd)

		Aborted First Run		Second Run				
Category	Component, Concentration	INF-1[2]	WW-1[3]	FEED-2[4]	WW-2[5]	DEC-2[6]	SD-2[7]	SD-2D[8]
Metals	Aluminum (Al), mg/l	---	---	---	---	0.75	---	---
	Antimony (Sb), mg/l	---	---	---	---	<0.01	---	---
	Arsenic (As), mg/l	---	---	---	---	0.036	---	---
	Barium (Ba), mg/l	---	---	---	---	<0.2	---	---
	Beryllium (Be), mg/l	---	---	---	---	<0.01	---	---
	Calcium (Ca), mg/l	---	---	---	---	870	---	---
	Cadmium (Cd), mg/l	---	---	---	---	1.6	---	---
	Chromium (Cr), total, mg/l	---	---	---	---	70	---	---
	Chromium (Cr), hexavalent, mg/l	---	---	---	---	72	---	---
	Cobalt (Co), mg/l	---	---	---	---	<0.05	---	---
	Copper (Cu), mg/l	---	---	---	---	0.47	---	---
	Iron (Fe), mg/l	---	---	---	---	0.15	---	---
	Mercury (Hg), mg/l	---	---	---	---	1.4	---	---
	Potassium (K), mg/l	---	---	---	---	20	---	---
	Magnesium (Mg), mg/l	---	---	---	---	91	---	---
	Manganese (Mn), mg/l	---	---	---	---	0.79	---	---
	Nickel (Ni), mg/l	---	---	---	---	<0.05	---	---
	Silver (Ag), mg/l	---	---	---	---	<0.05	---	---
	Sodium (Na), mg/l	---	---	---	---	21	---	---
	Lead (Pb), mg/l	---	---	---	---	0.11	---	---
	Selenium (Se), mg/l	---	---	---	---	0.13	---	---
	Thallium (Tl), mg/l	---	---	---	---	<0.05	---	---
	Vanadium (V), mg/l	---	---	---	---	<0.05	---	---
	Zinc (Zn), mg/l	---	---	---	---	34	---	---

(1) Values listed with a "<" symbol denote that the species concentration was below the listed detection limit (e.g., <1.0 mg/l denotes that the species was not detected at a detection limit of 1.0 mg/l.
(2) INF-1 = Sludge feed for test of 4/27/98.
(3) WW-1 = Wastewater sample (composite SCWO process effluent) from test of 4/27/98.
(4) FEED-2 = Sludge feed for test of 4/29/98.
(5) WW-2 = Wastewater sample (composite SCWO process effluent) from test of 4/29/98.
(6) DEC-2 = Wastewater decant sample (SCWO effluent liquid fraction only) from test of 4/29/98.
(7) SD-2 = Wastewater solids sample (SCWO effluent solids fraction only) from test of 4/29/98.
(8) SD-2D = Wastewater solids sample (SCWO effluent solids fraction only) from test of 4/29/98 (duplicate of SD-2).
(9) No dioxin/furan compounds were detected. Detection limits ranged from 0.06 to 0.57 ppt.
(10) No dioxin/furan compounds were detected. Detection limits ranged from 0.05 to 0.32 ppt.
(11) Concentrations of approximately 57 semivolatile species were measured with detection limits ranging from 5 to 40 µg/l. None were detected.
(12) Concentrations of approximately 29 volatile species were measured with detection limits ranging from 1 to 3 µg/l. Three species were detected, one of which was most likely due to contamination of the blank (see Footnote 13 below).
(13) Methylene chloride was also detected during the method blank analysis, so its presence was most likely due to contamination during analysis and not due to the SCWO process.

TABLE 3
GASEOUS EFFLUENT ANALYSIS RESULTS
FOR DAYTON PCB-CONTAMINATED SLUDGE TESTING(1)

Category	Component, Concentration	Sample Designation	
		GAS-2(2)	GAS-2D(3)
PCBs	Monochlorobiphenyl, ppt	<4.2	<4.2
	Dichlorobiphenyl, ppt	<3.5	<3.5
	Trichlorobiphenyl, ppt	<3.1	<3.1
	Tetrachlorobiphenyl, ppt	<2.7	<2.7
	Pentachlorobiphenyl, ppt	<2.4	<2.4
	Hexachlorobiphenyl, ppt	<2.2	<2.2
	Heptachlorobiphenyl, ppt	<2.0	<2.0
	Octachlorobiphenyl, ppt	<1.8	<1.8
	Nonachlorobiphenyl, ppt	<1.7	<1.7
	Decachlorobiphenyl, ppt	<1.6	<1.6
Dioxins/Furans	OCDD(4), ppt	0.009	0.009
	HpCDF(5), ppt	0.022	0.006
	OCDF(6), ppt	0.017	0.011
Organics	Methane, ppm (v/v)	<2	<2
	TGNMO(7), ppm as methane (v/v)	27	25

(1) Values listed with a "<" symbol denote that the species concentration was below the listed detection limit (e.g., <1.0 mg/l denotes that the species was not detected at a detection limit of 1.0 mg/l.
(2) GAS-2 = Gaseous effluent sample from test of 4/29/98.
(3) GAS-2D = Gaseous effluent sample from test of 4/29/98 (duplicate of GAS-2).
(4) OCDD = Octachlorodibenzodioxin
(5) HpCDF = Heptachlorodibenzofuran
(6) OCDF = Octachlorodibenzofuran
(7) TGNMO = total gaseous non-methane organics.

6. DISCUSSION

A review of the equipment performance and analytical results for the PCB-contaminated sludge testing was performed, and the major areas of interest are discussed further below.

6.1. Sludge Pumping

GA has developed a proprietary slurry pumping system specifically for sewage sludge and other viscous, solids-containing feed streams. This system has been successfully operated over the past 18 months in support of numerous test programs. For the Dayton program, the system performed very well with no plugging problems. Prior to use in testing, the feed was processed through a commercial grinder to ensure uniformity of feed and to size-reduce large sludge components. For full-scale SCWO applications for sludge feeds, the grinder could be placed in-line, upstream of the slurry feed system.

6.2. Pressure Letdown

GA has experience with a variety of pressure control techniques for SCWO applications. The simplest scenario involves use of a pressure control valve (or valves in series) to let down the system pressure for the combined liquid, solid (if present), and gas phases. For low-solids effluent streams and non-abrasive solids-containing streams, this configuration is reasonable for long-term, reliable operation with appropriate valve stem and seat materials. For highly abrasive solids-containing streams, this configuration is not adequate, and GA has developed a reliable system that makes use of a high-pressure liquid/gas separator. Based on the favorable results of the non-contaminated Dayton sludge testing, the simplest scenario appeared to be reasonable. When during the aborted run of 4/27/98 this was found not to be the case, GA installed the liquid/gas separator system for enhanced abrasion resistance. Testing was then completed without further detectable wear of the pressure letdown system components. Pressure control was excellent throughout the testing with this configuration. For a full-scale SCWO plant for Dayton sludge, a high-pressure liquid/gas separator-based pressure letdown system is recommended.

6.3. PCB Destruction

The liquid effluent from the test of 4/27/98 was analyzed by Black & Veatch and found to contain no PCBs at the detection limits of 0.5 μg/l. Because of excessive erosion of the pressure letdown system, as originally configured, this test was prematurely terminated to allow installation of GA's standard pressure letdown system for abrasive feeds. Testing was then completed on 4/29/98. During analysis of samples from the 4/29/98 test, Black & Veatch detected the presence of a low concentration (5.9 μg/l) of PCB 1260. The detection of PCBs in the SCWO effluent was surprising given that past testing had shown these compounds to be readily destroyed under the conditions used during testing at GA. We immediately suspected that the failure of the pressure letdown system during the prior test had resulted in partial contamination of the piping downstream of the reactor. We therefore sent an effluent sample collected prior to the start of sludge feed for the test of 4/29/98. (GA routinely collects such samples to establish background levels during all test programs.) This sample was analyzed by Southwest Research Institute of San Antonio, Texas and was found to contain 80.4 µg/l of PCB 1260 (analysis attached). Therefore, given the non-detection of PCBs during the prior test, coupled with the baseline sample results, it is reasonable to assume that the PCBs detected in the liquid effluent from the test of 4/29/98 were due to contamination of the downstream piping during the prior test and not due to poor performance of the SCWO system.

No PCBs were detected in the gaseous effluent samples for either PCB sludge test, thus confirming good destruction.

6.4. Dioxin/Furan Analyses

The total dioxin/furan concentration measured in the gas phase was 0.026 to 0.048 ppt. These concentrations are extremely low, but to determine whether they represent a problem for a full-scale facility, one needs to estimate the total yearly release for comparison with allowable release limits. Based on the raw data from the analytical laboratory, the average total dioxin/furan concentration (corresponding to one hour of pilot plant operation) was 39.5 pg. For one hour of pilot plant operations, we therefore have:

(39.5 pg D/F)/(0.64 kg/min)*(60 min) = 1.029 pg D/F/kg of 13.5 wt% PCB-contaminated sludge.

Assuming the same ratio for a full-scale plant, the yearly release of dioxins/furans for destruction of 100,000 dry tons of sludge (assuming a 12-year plant lifetime and a 10 wt% solids concentration in the feed) is:

(1,000,000 wet tons/12 yr)*(10 wt% solids basis/13.5 wt% solids pilot test)
(2000 lb/ton)(kg/2.2 lb))*(1.029 pg D/F/kg) = 5.77×10^7 pg D/F/yr = **1.27×10^{-7} lb D/F/yr**

From Ref. 1, the allowable release limit of dioxins and furans below which no risk assessment is required is 1.3×10^{-7} lb/yr. The estimated release limits for a full-scale PCB-contaminated sewage sludge treatment plant for the City of Dayton fall below this limit, so no risk assessment due to potential dioxin/furan releases to the environment should be required. A full-scale facility should also contain a charcoal filter for the gaseous effluent stream to provide additional margin and an added layer of environmental protection.

6.5. TCLP Metals

As shown previously in Table 2, Toxicity Characteristic Leaching Procedure (TCLP) analyses were performed on the SCWO solids to help determine ultimate disposal requirements. TCLP analyses were performed on eight different metals, five of which (arsenic, barium, lead, selenium, silver) had concentrations below detection limits. The remaining three metals (cadmium, chromium, and mercury) were measured at very low concentrations. Although detected in the TCLP leachate, the concentrations of chromium (1.4 mg/l) and mercury (0.0066 to 0.0068 mg/l) were below the allowable limits of 5 mg/l and 0.2 mg/l, respectively. The TCLP leachate concentration for cadmium of 1.2 to 1.4 mg/l was slightly above the allowable limit of 1 mg/l. For full-scale applications, a longer reactor residence time will be provided to ensure more complete conversion of cadmium species to the insoluble oxide during SCWO.

7. CONCLUSIONS

- PCBs contained in Dayton contaminated sewage sludge can be effectively destroyed via SCWO. PCB concentrations in the effluent were below detection limits for the initial PCB test. The low-level concentration of PCB 1260 present in the effluent from the second test was due to contamination of the effluent collection piping during the shutdown of the first test, as shown by the presence of PCB 1260 in a sample collected prior to the start of the second test.

- The GA proprietary pumping system worked well. Dayton sewage sludge was reliably and continuously pumped through the SCWO system without any signs of plugging.

- The use of a high-pressure liquid/gas separator in conjunction with separate liquid and gas pressure letdown effectively reduced erosion and provided reliable SCWO system pressure control.

- The PCB-contaminated sludge tests described herein were only of several hours duration. Additional pilot plant testing should be performed to establish longer-term reliability data.

- No dioxins/furans were detected in the SCWO liquid effluent. Dioxin/furan concentrations in the SCWO gaseous effluent were extremely low (<<1 ppt). As an additional precaution for full-scale application, the SCWO gaseous effluent could be routed through a charcoal filter prior to release to the environment.

- The solid residue from SCWO processing passed TCLP testing with the exception of cadmium (1.2 to 1.4 ppm) which was slightly above the allowable limit of 1.0 ppm. Additional residence time will be included for full-scale applications to ensure complete conversion of cadmium to the insoluble oxide.

9. REFERENCES

1. Keck, D. of Black & Veatch, telephone conversation with K. Downey of General Atomics, September 25, 1998.